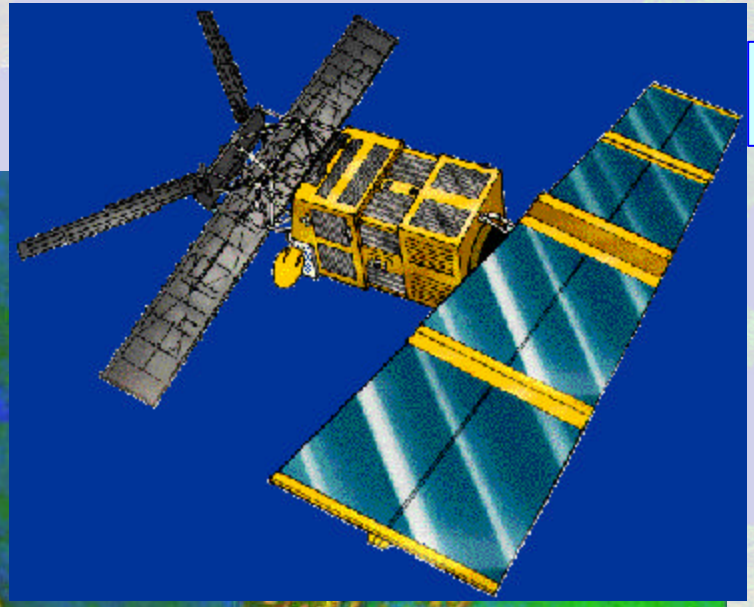
ERS 1/2 and ENVISAT

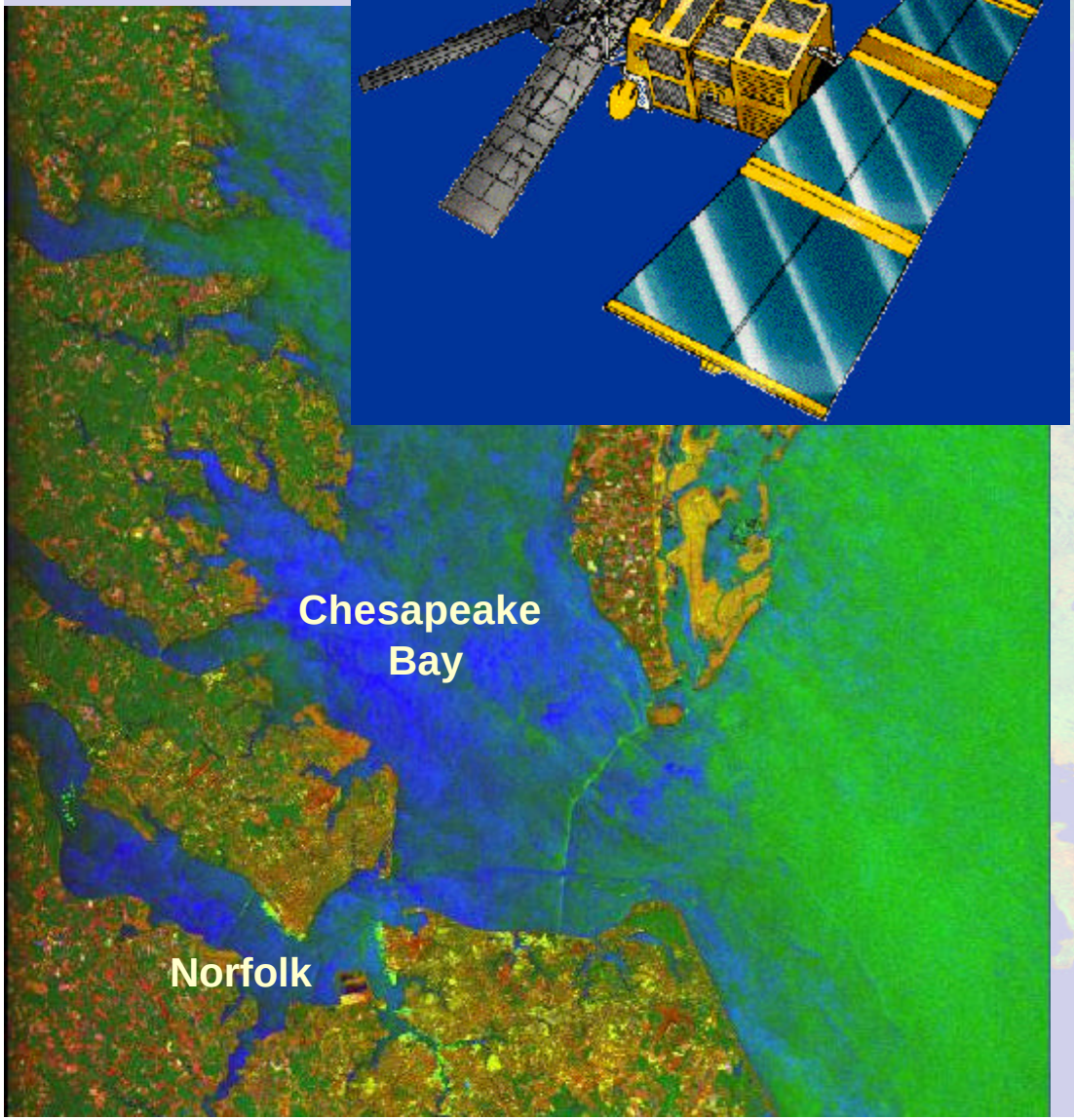
Three European missions providing SAR data for practical applications

Henri Laur

ESA Earth Observation
Mission Management Office



ERS-1: a European success



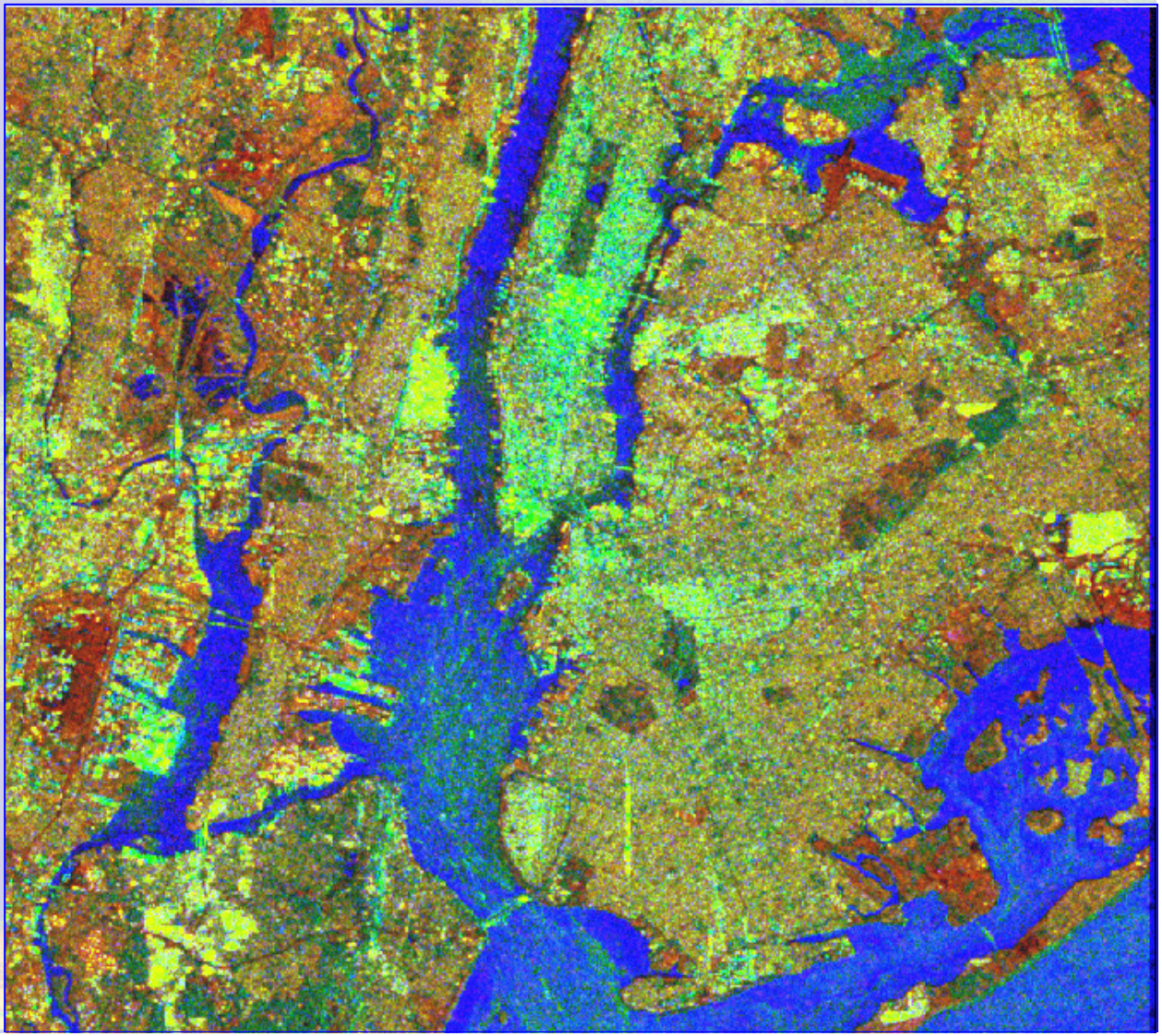
1991 - 2000

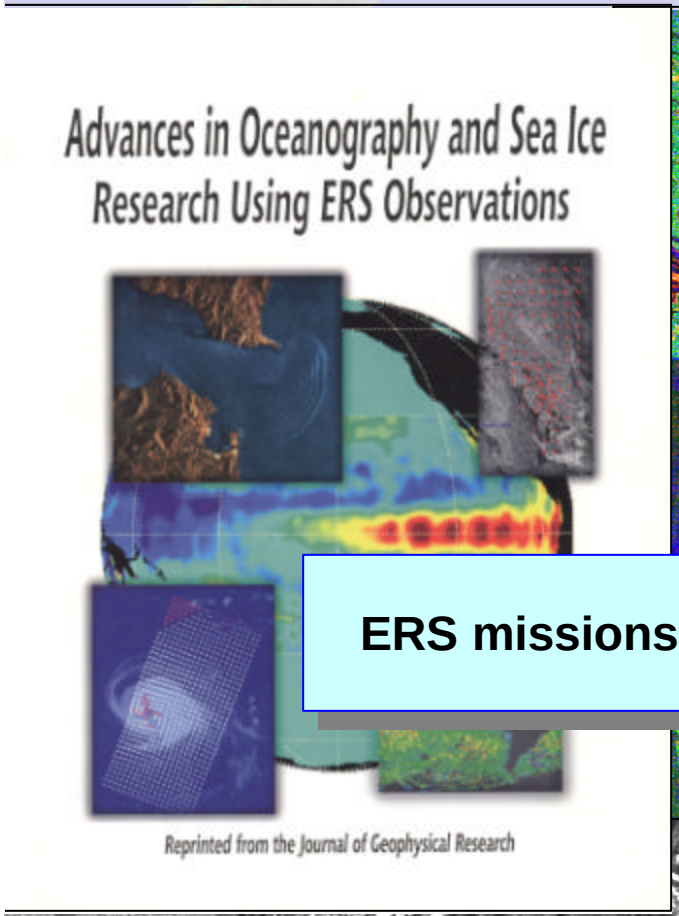
- **9 years of excellent service (3 times its planned lifetime)**
- **45200 orbits**
- **1.4 million archived SAR scenes**
- ***microwave remote sensing comes of age***

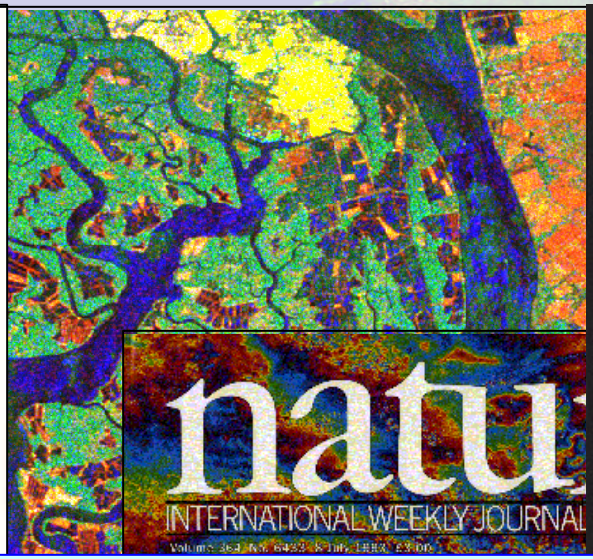
ERS-2 : SAR applications become mature

ERS-2 Status:

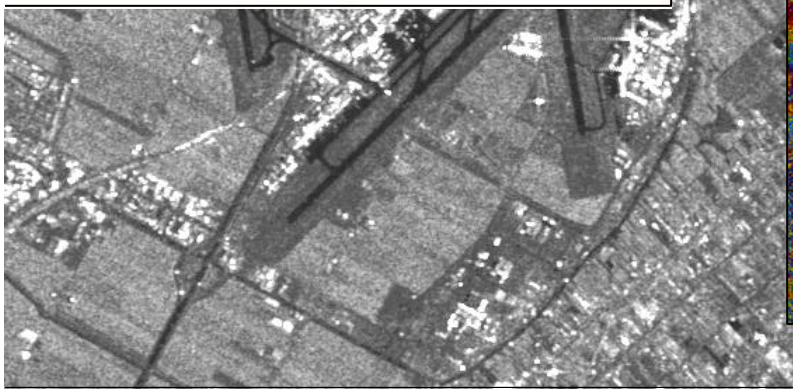
- **operational since 6 years**
- **mono-gyro operations from February 2000 to January 2001**
- **coarse attitude control mode operations since February 2001**
- **instruments nominally working, however degradation in data due to attitude control**
- **precise gyro-less operations mode to be uploaded in summer 2001**

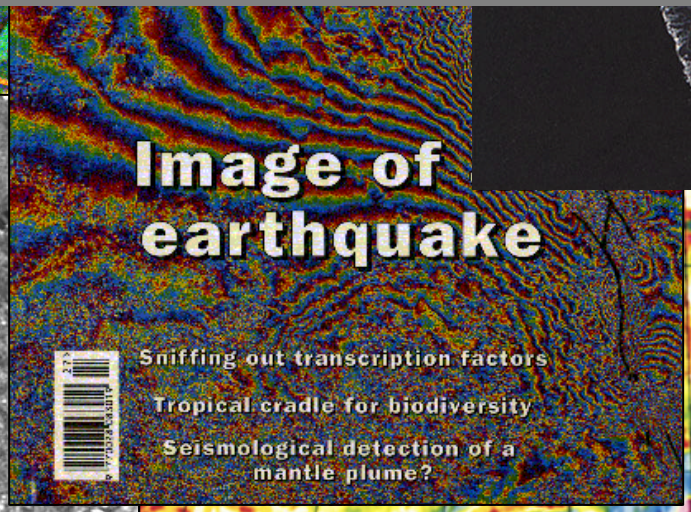


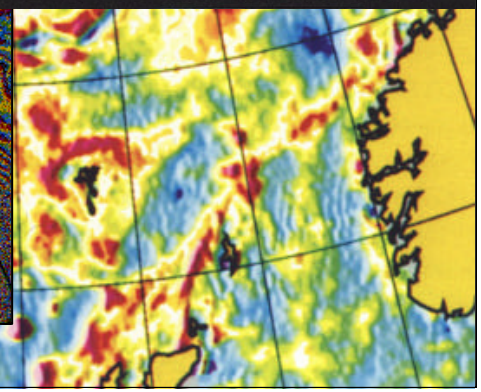




ERS missions: the “radar way” to observe the Earth

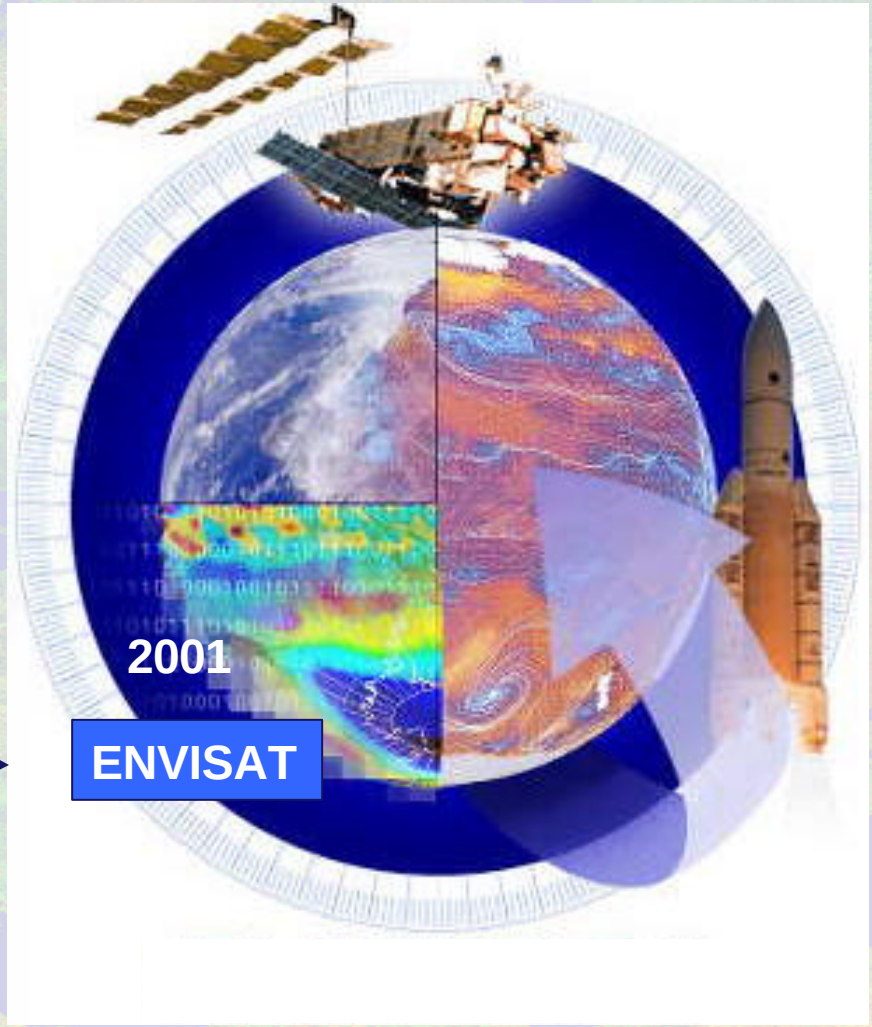






ENVISAT:

Europe's expanding capacity



1991 **ERS 1** → **1995** **ERS 2** → **2001** **ENVISAT**

Oceans
Sea Ice
Cryosphere
Land Surface
Climatology

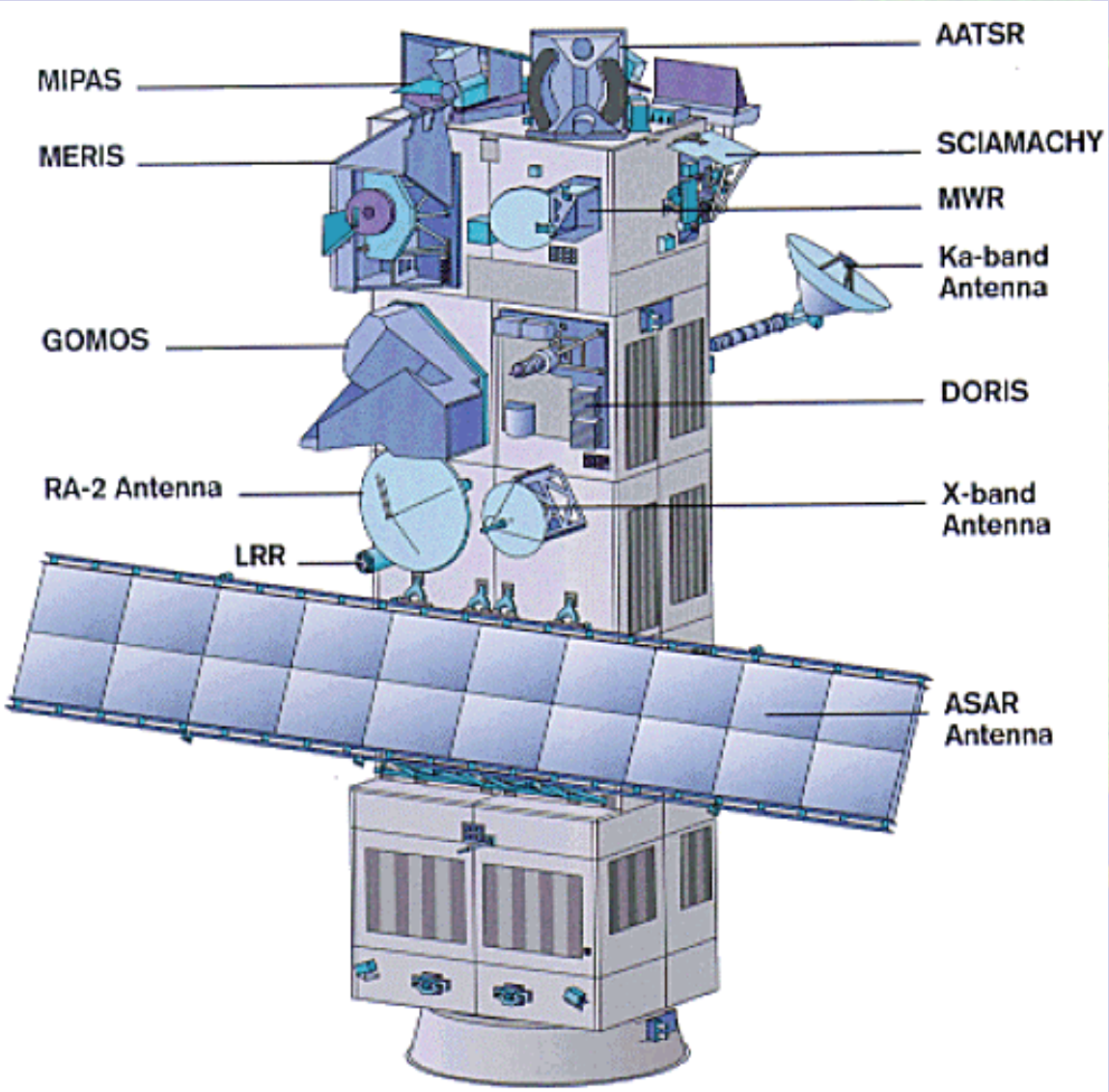
→ *+ Global Ozone*
+ enhanced ATSR

→ *+ Ocean Colour*
+ Atmospheric Constituents

Mission objectives

- to provide for **continuity** of the observations started with the ERS satellites, including those obtained from radar-based observations,
- to provide for **enhancement** of the ERS missions, notably the ocean and ice mission,
- to **extend** the range of parameters observed, to meet the need to increase knowledge of the factors determining the environment,
- to make a significant contribution to **environmental studies**, notably in the areas of atmospheric chemistry and ocean studies (including marine biology).

ENVISAT payload

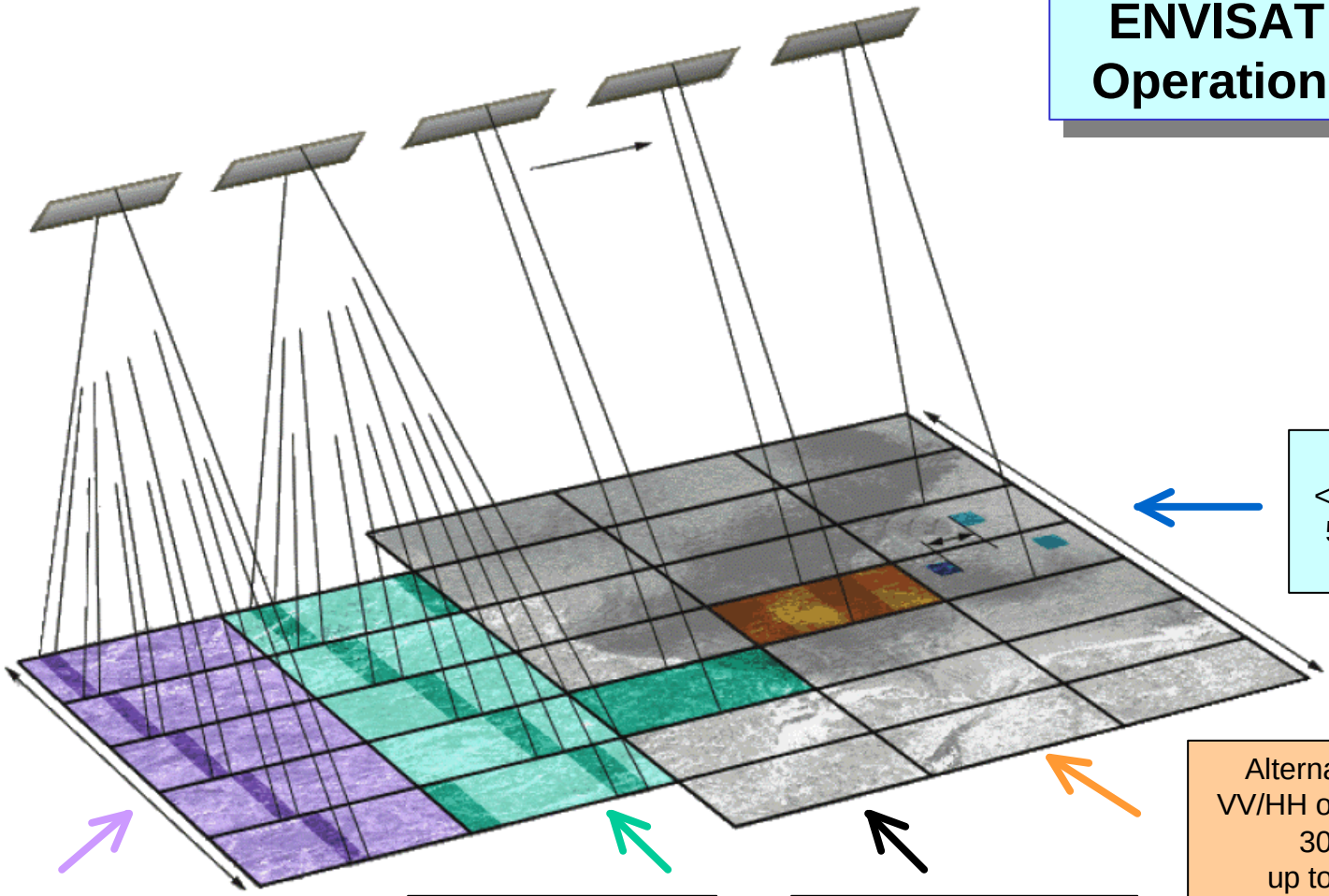


- ***Dimensions***
  - Launch configuration:
    - length 10.5 m
    - envelope diameter 4.6 m
  - In-Orbit configuration:
    - 26m x 10m x 5m
- ***Mass***
  - Total satellite 8140 Kg
  - Payload 2050 Kg
- ***Power***
  - Solar array power:
    - 6.5 kW (EOL)
  - Average power demand:

	Sun (watts)	Eclipse (watts)
Payload	1700	1750
Satellite	3275	2870

- ***Launch vehicle***
  - Ariane 5 (single launch)
- ***Orbit***
  - 800 km as ERS, sun synchronous 10:00, i.e. 30 minutes before ERS-2

ENVISAT ASAR Operation Modes



Wave VV or HH
< 10m resolution (SLC)
5 x 5 km to 10 x 5 km
vignettes

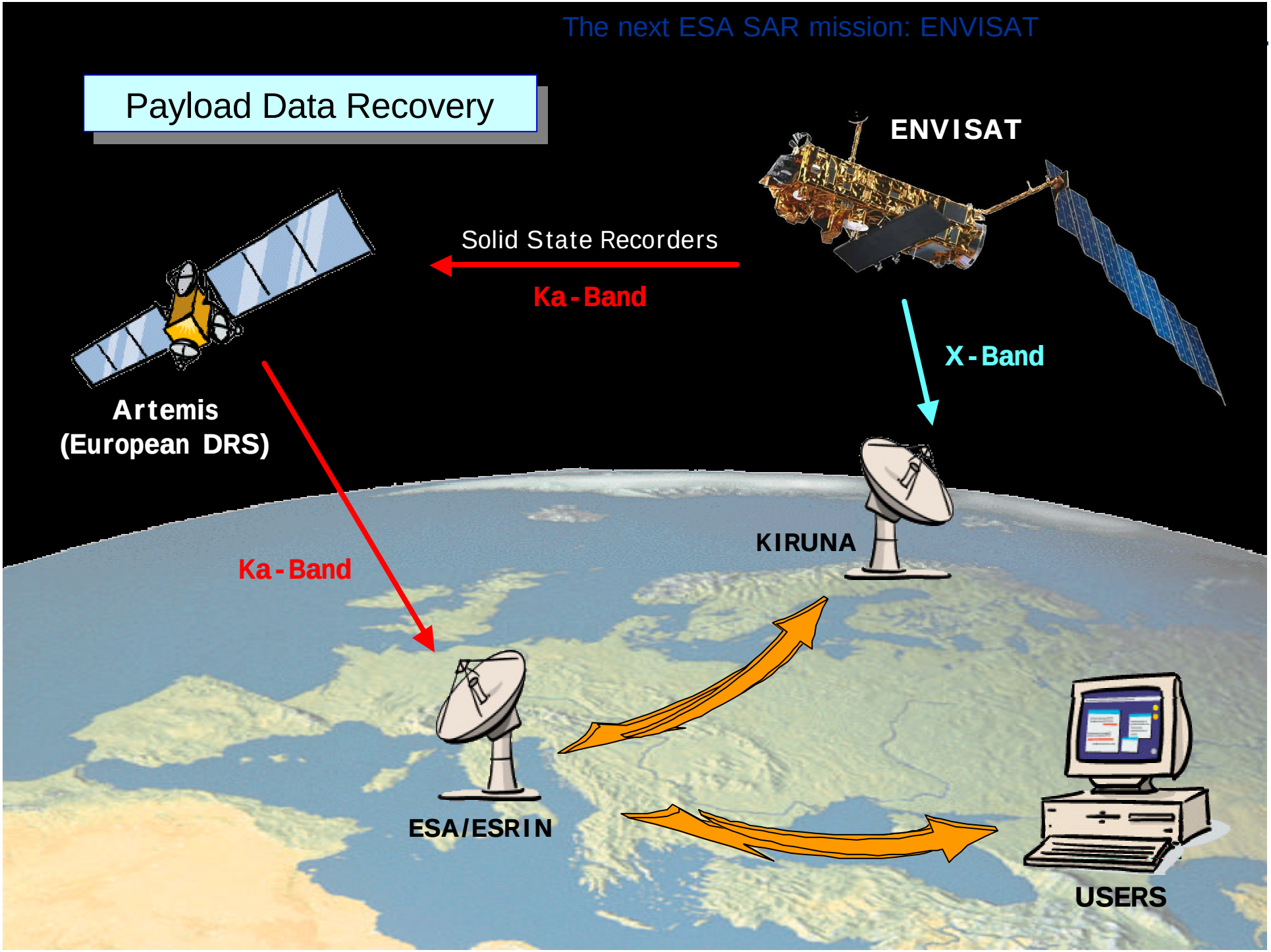
Alternative Polarisation
VV/HH or VV/VH or HH/HV
30m resolution
up to 100 km swath

Global Monitoring
VV or HH
1000m resolution
405 km swath width

Wide Swath
VV or HH
150m resolution
405 km swath width

Image VV or HH
< 30m resolution
up to 100 km swath

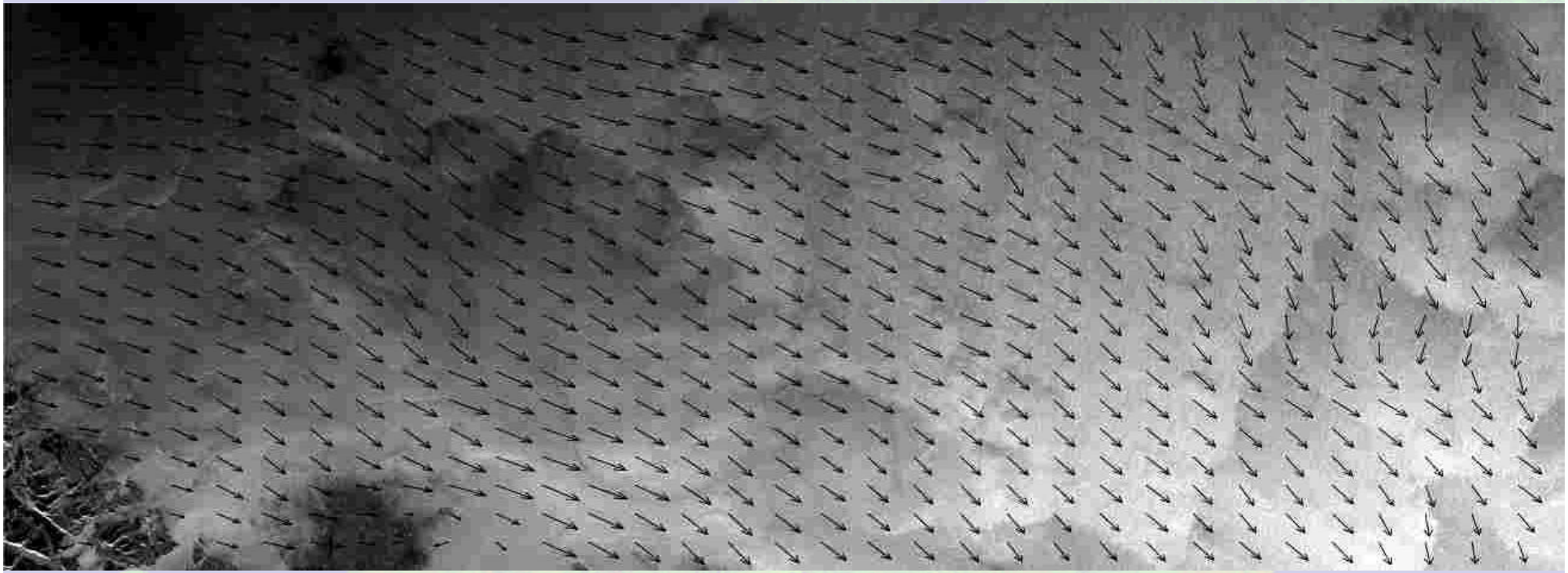
Payload Data Recovery



Some ASAR applications	Preferred ASAR mode
Ship routing (sea ice extent)	Wide Swath (HH)
Ship detection	Alternating Polarisation (HH/HV)
Oil slicks	Wide Swath (VV)
Bathymetry	Image Mode (HH)
Marine meteorology	Wide Swath (VV)
Wind/wave models	Wave Mode (VV)
Glacier/ice sheet motion	Image Mode (HH or VV)
Ice sheet extent and melt areas	Wide Swath (HH or VV)
Snow climatology	Wide Swath or Global MM (HH or VV)
Geological mapping	Image Mode (HH)
Land subsidence, earthquakes, volcanoes	Image Mode (HH or VV)
Water management (runoff forecast, flooding)	Wide Swath (HH or VV)
Agriculture (crop area)	Alternating Polarisation (VV/VH)
Agriculture (crop condition)	Image Mode (HH or VV)
Agriculture (soil moisture)	Wide Swath (VV)




Ocean Wind Retrieval

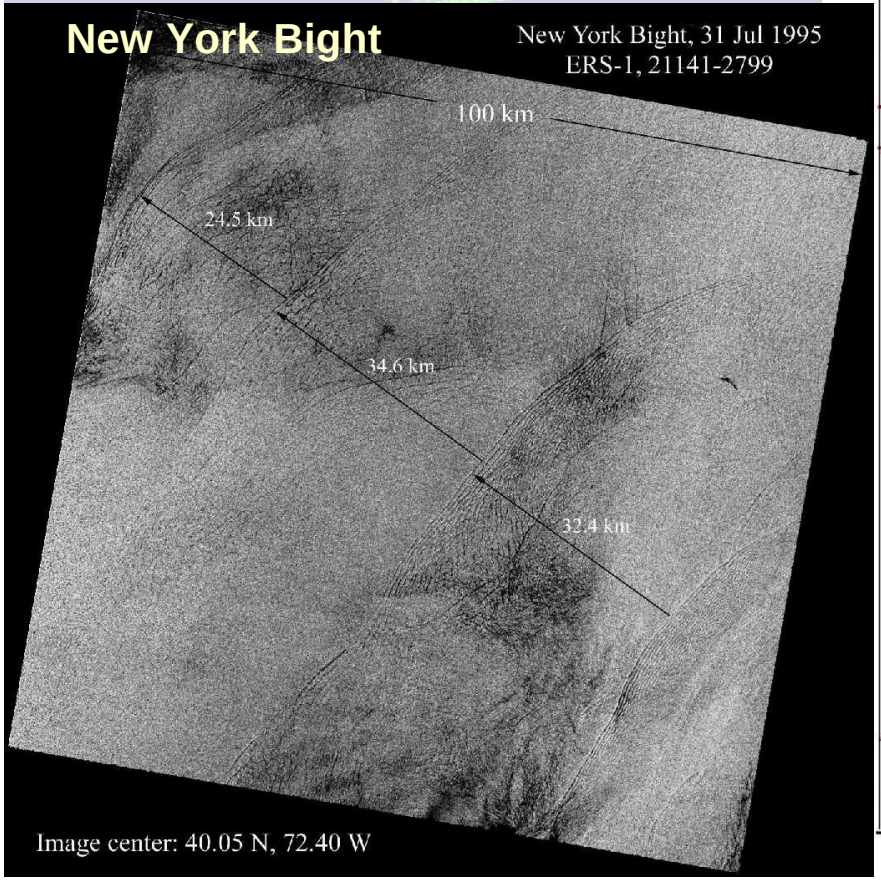


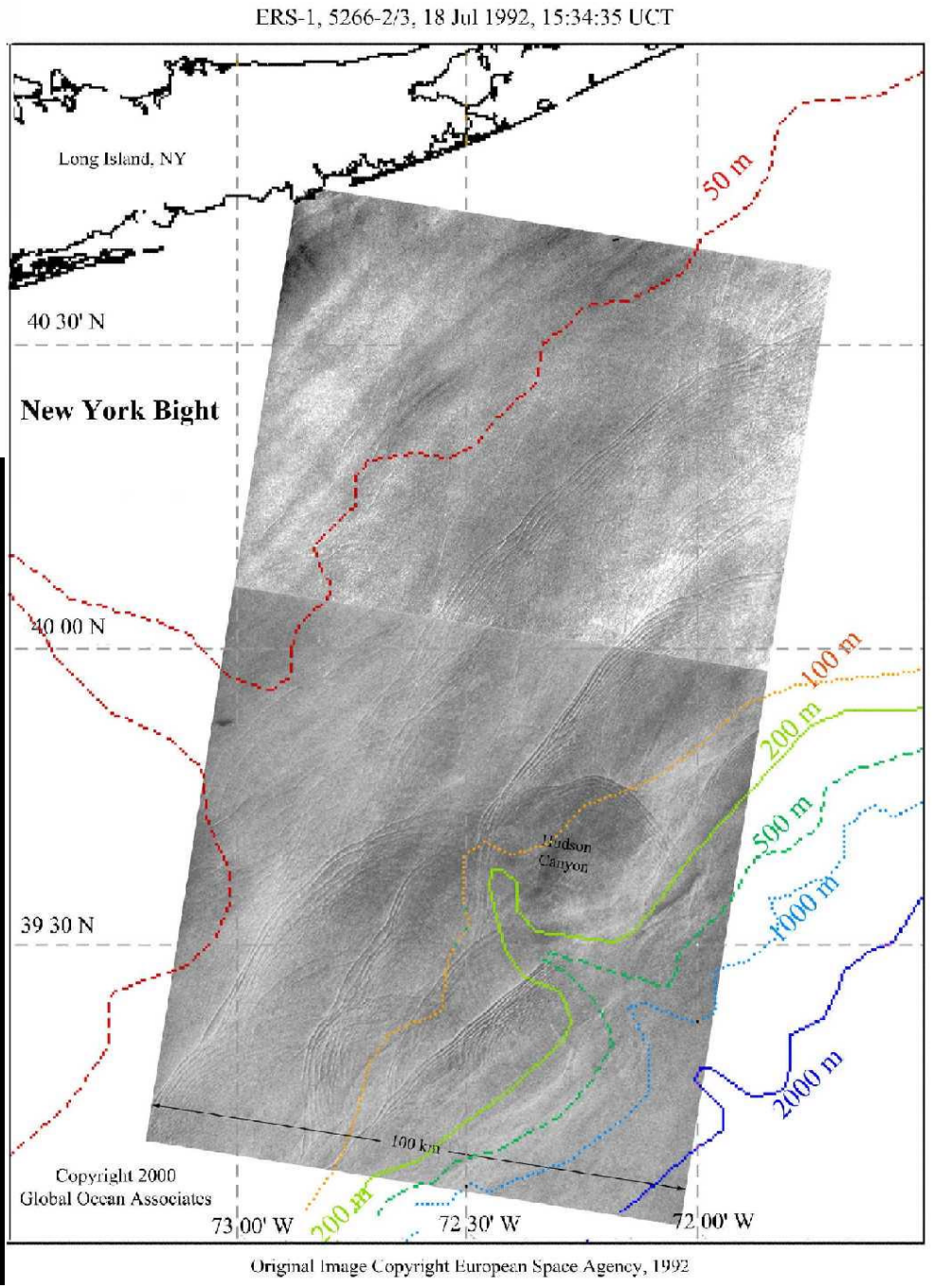
- *ENVISAT ASAR complex data (SLC) will provide wind field estimates:*
  - *speed: < 2 m/s (RMS error)*
  - *direction: < 20 degrees (RMS error)*

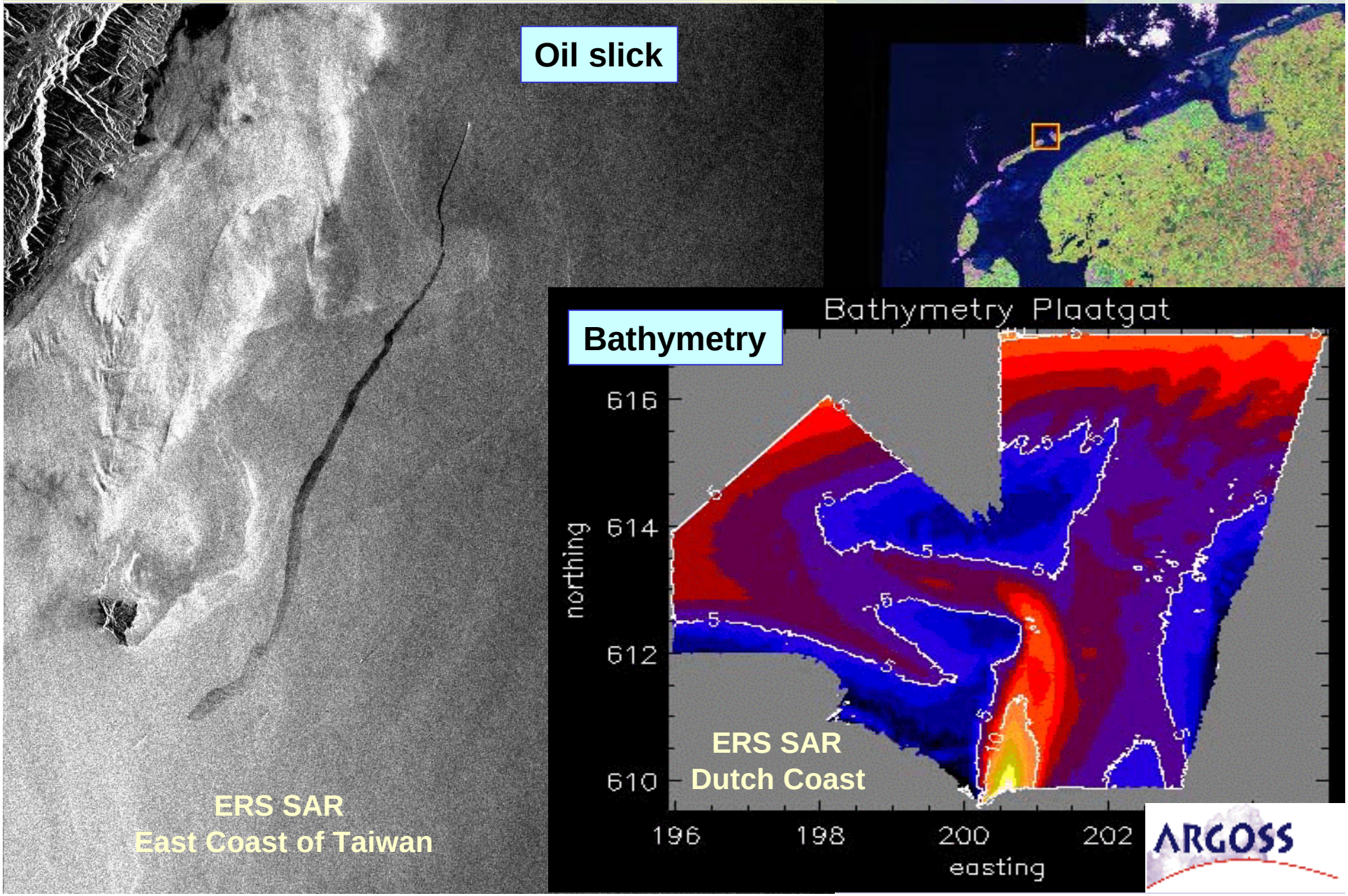
- *Prototype algorithm is currently under validation with ERS data at TSS (Norway).*
- *The algorithm developed by NORUT (Norway) requires calibrated SLC data.*

Internal Waves

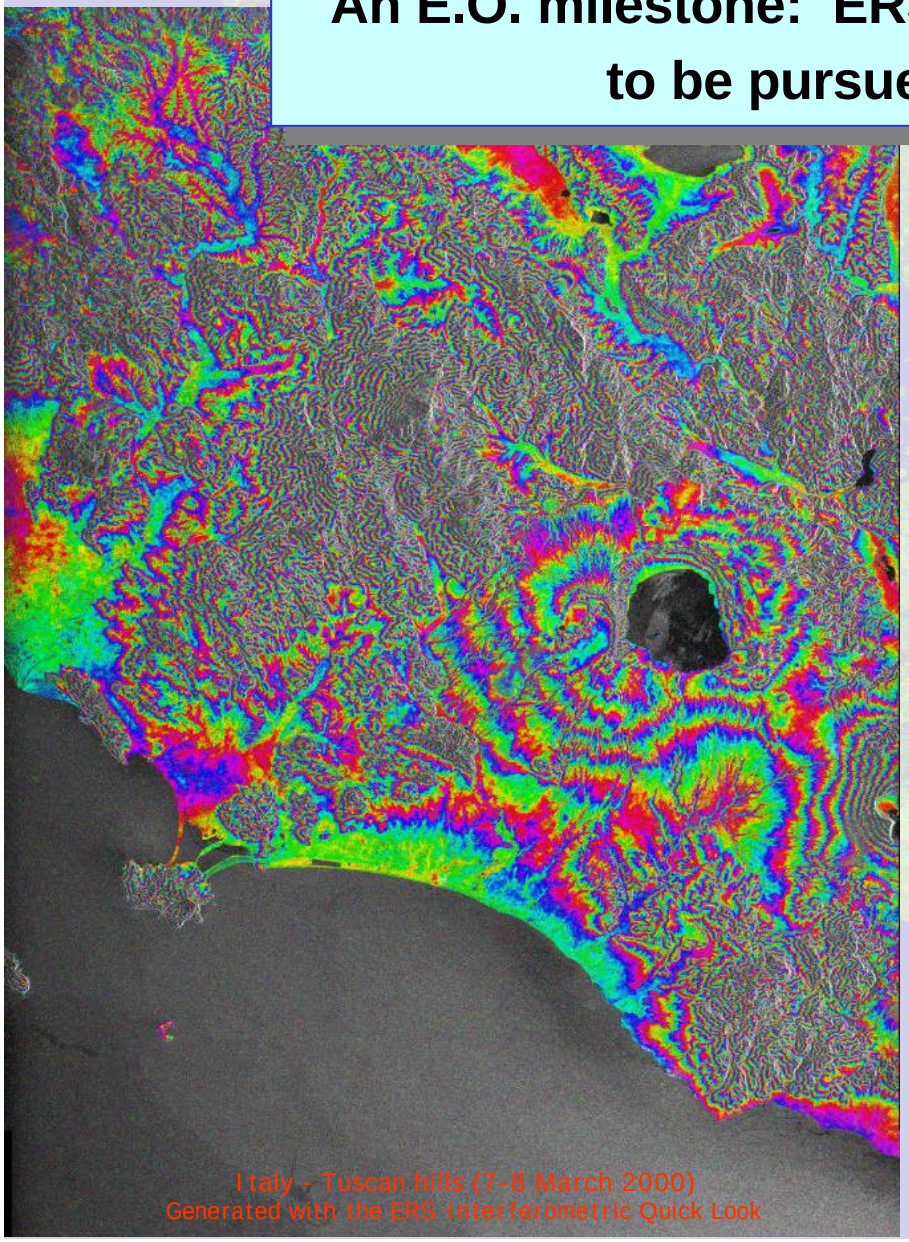
Observation with different modes, incidence angles, polarisation combinations






Oil slick
Bathymetry
Bathymetry Plaatgat
616
614
612
610
northing
196
198
200
202
easting
ERS SAR
Dutch Coast
ERS SAR
East Coast of Taiwan
ARGOSS

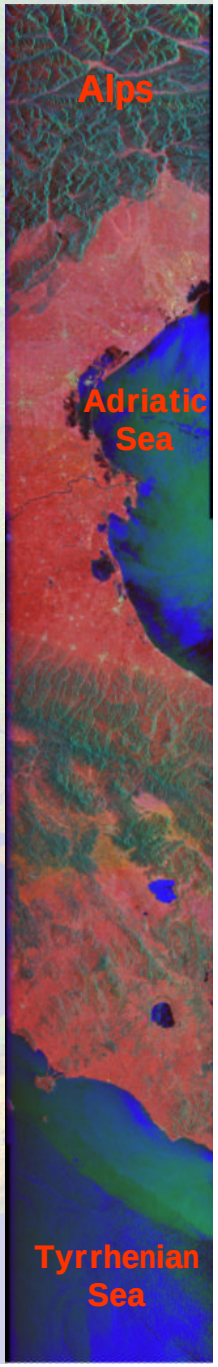
An E.O. milestone: ERS and SAR Interferometry to be pursued by ENVISAT



Last acquired ERS-1 SAR data

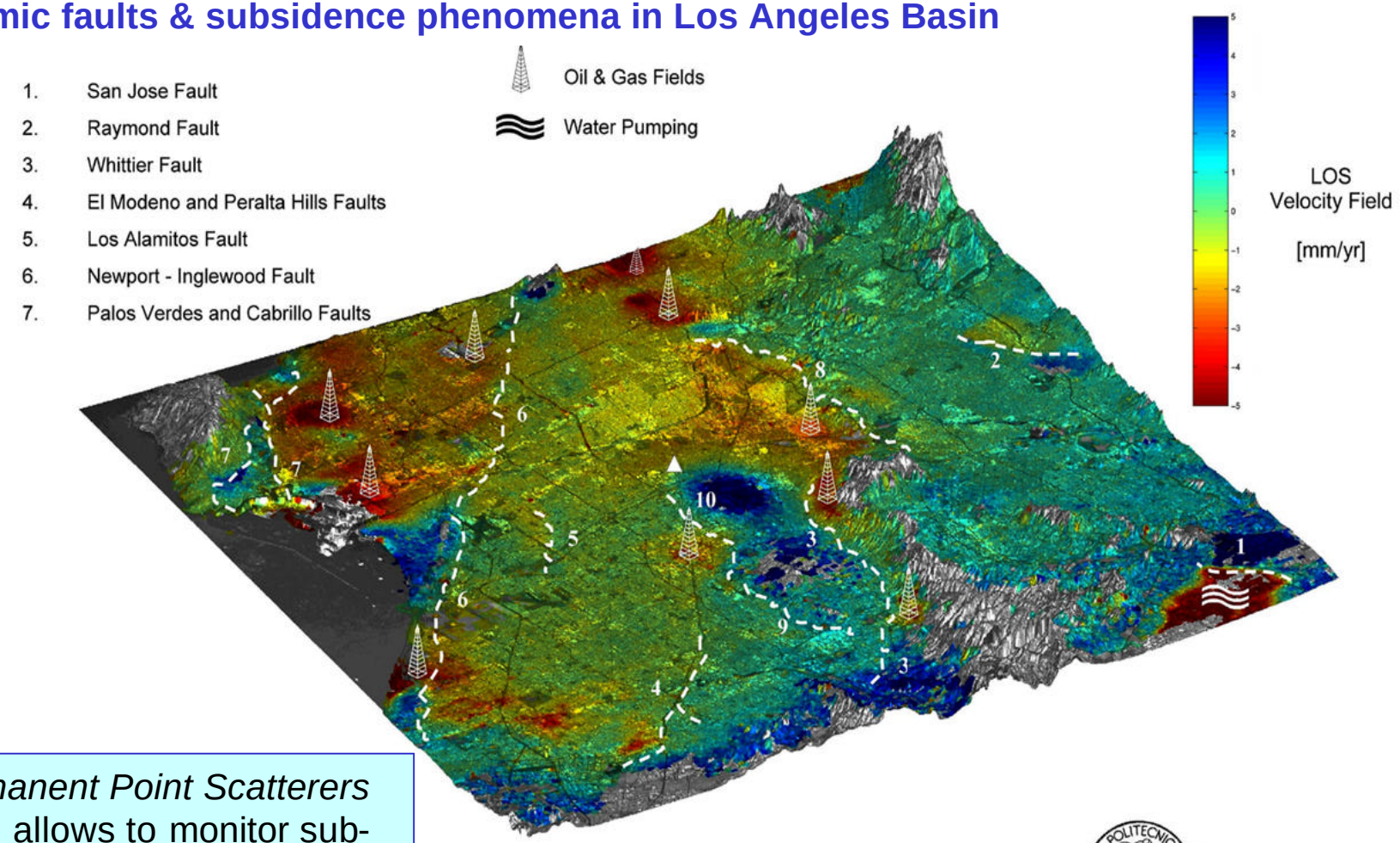
(7 March 2000)

- **Images generated with ERS-1 and ERS-2 SAR data, using the technique of *interferometry*, made popular by ERS-1.**
- **Both images highlight the outstanding data quality of the ERS-1 satellite until its last moments of operation.**



ERS missions: an highly valuable SAR archive to be exploited by ENVISAT

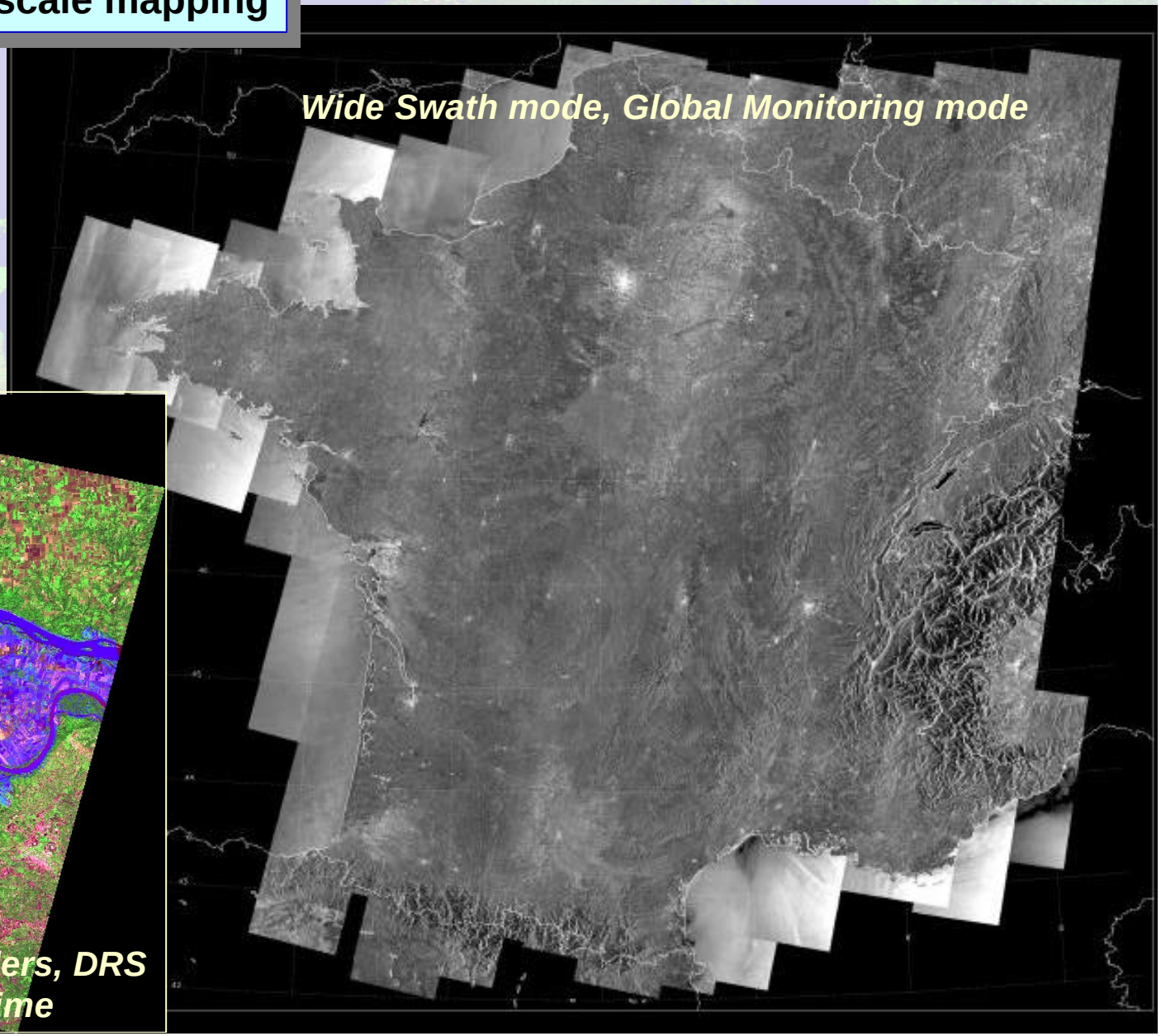
Seismic faults & subsidence phenomena in Los Angeles Basin



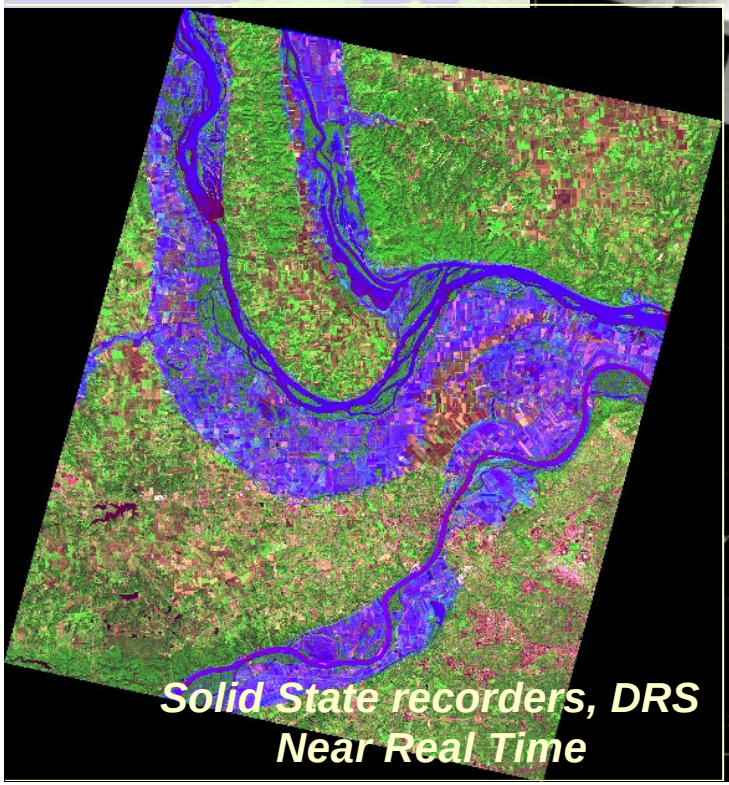
The *Permanent Point Scatterers* technique allows to monitor sub-millimetric mouvement of buildings for a period of already 9 years

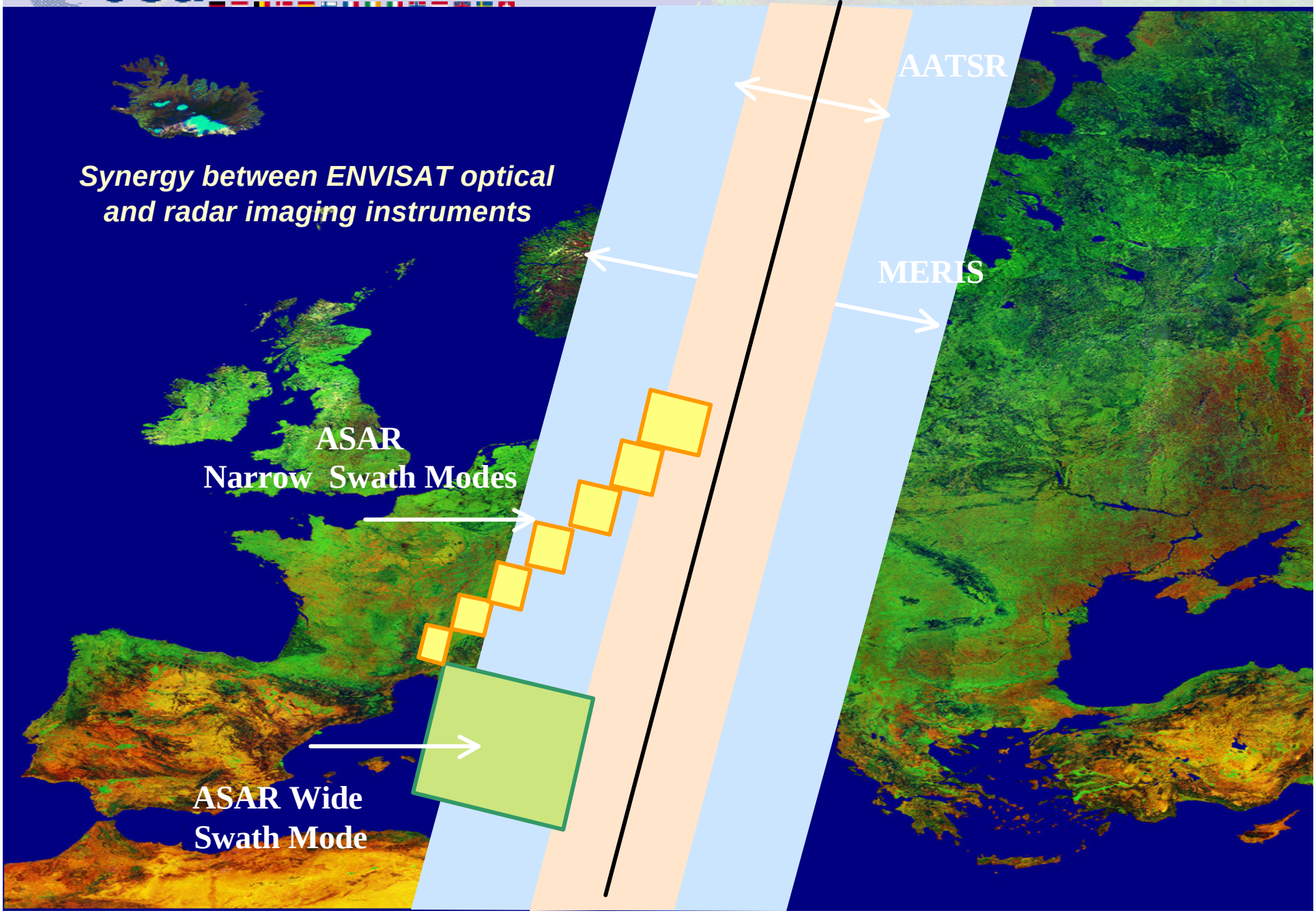
T.R.E.

Large scale mapping



Flooding




Synergy between ENVISAT optical and radar imaging instruments
AATSR
MERIS
ASAR
Narrow Swath Modes
ASAR Wide
Swath Mode

ESA Data Policy

Data policy defined by ESA Member States:

- **to maximize the beneficial use of data from both ERS and ENVISAT satellites,**
- **to stimulate a balanced development of Science, Public Utility and Commercial Applications, consistent with the mission objectives.**

Category 1 use

- **Research and applications development use in support of the mission objectives, including research on long term issues of Earth System science,**
- **Research and development in preparation for future operational use.**

Category 2 use

All other uses which do not fall into Category 1, including operational and commercial utilisation.

ERS/ENVISAT Data Distribution

Project purpose	Distribution responsible	Data/Service Costs
Category 1 Research, Cooperation Projects (e.g. AO)	esa using ESA facilities/stations	costs of reproduction free data if price waived by Member States (yearly basis)
Category 2 Application & Operational Services	**competing Distributing Entities** using ESA facilities and/or agreements with non-ESA stations	Defined by competing Distributing Entities

Category 1 use (i.e. Research)

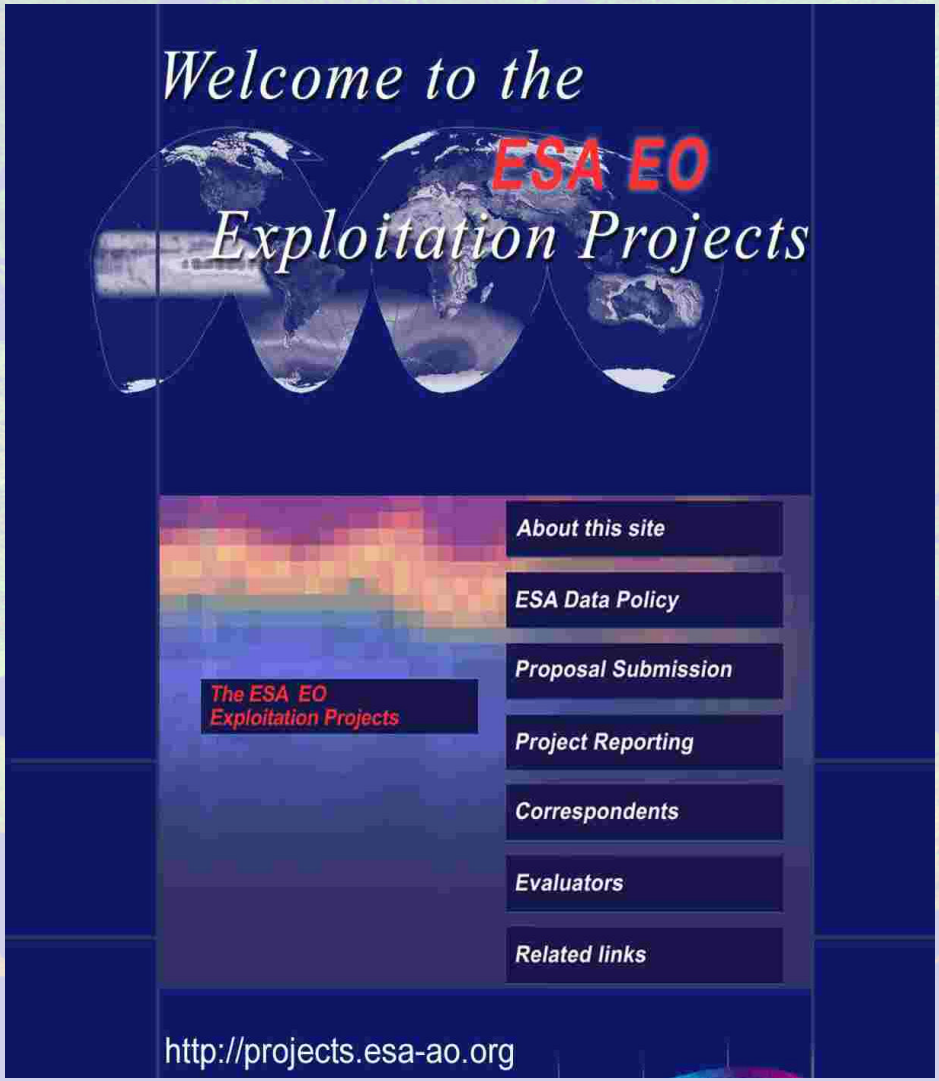
- Better support to A.O. PI's through Project Correspondents and Results Reporting Web Site.

- Easier and faster to start new projects under the ESA EO Data Policy.

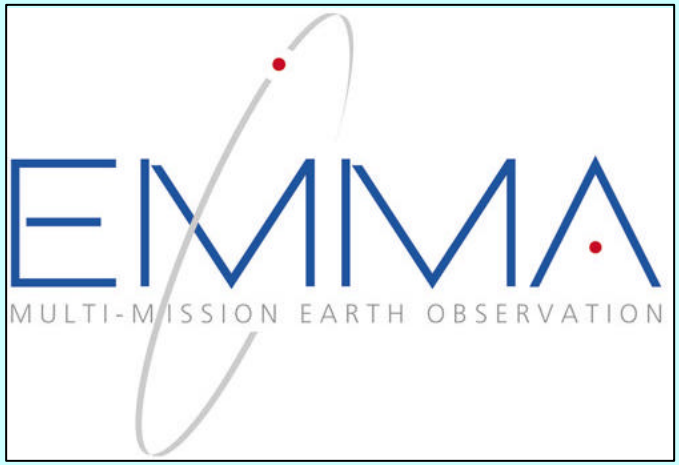
- Category 1 Advisory Group to peer review new proposals (international panel of scientists).

- Single web site for the exploitation and promotion of scientific projects:

http://projects.esa-ao.org



ESA EO Data Distributing Entities: who are they ?



EMMA

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DERA, DLR, Telespazio (Ground Stations)
ASI, Astrium, DERA, DLR, Infoterra, Telespazio (Value Adders)

Symposium Exhibitor
Contact persons: Mr. Apponi, Mrs. Di Domenico

SARCOM

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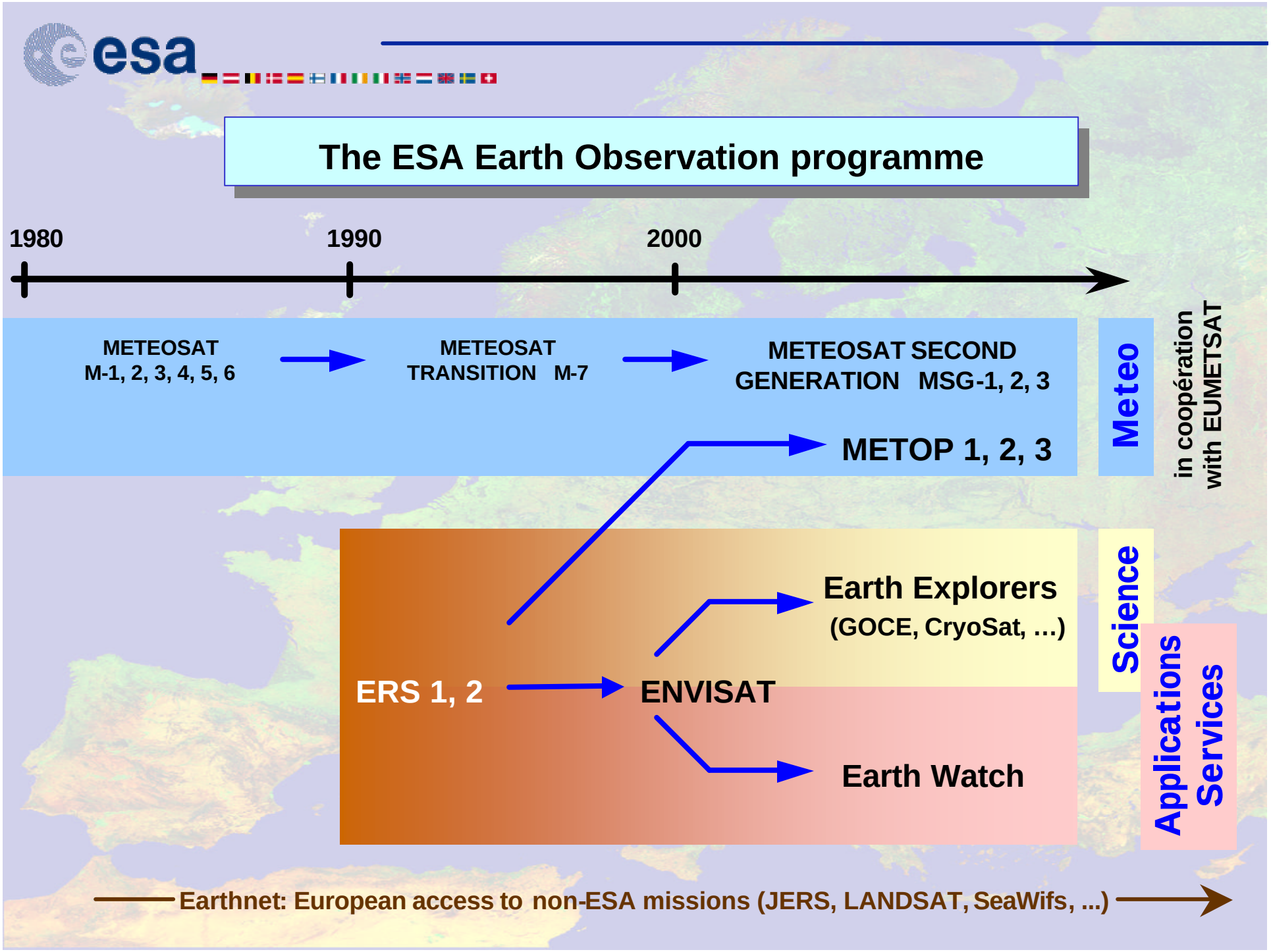
SPOT Image
Spot Asia, GEOSERVE, NLR, NPA, RSI, SATELLUS,TSS

Contact person available during symposium: Mr. R. Danby (SICORP)


esa
The ESA Earth Observation programme
1980
1990
2000
METEOSAT
M-1, 2, 3, 4, 5, 6
METEOSAT
TRANSITION M-7
METEOSAT SECOND
GENERATION MSG-1, 2, 3
METOP 1, 2, 3
Meteo
in coopération
with EUMETSAT
ERS 1, 2
ENVISAT
Earth Explorers
(GOCE, CryoSat, …)
Earth Watch
Science
Applications
Services
Earthnet: European access to non-ESA missions (JERS, LANDSAT, SeaWifs, ...)

http://www.esa.int

http://envisat.esa.int

http://projects.esa-ao.org

ENVISAT

Europe's Contribution to
Global Monitoring of the Environment